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The lack of any specific statements regarding civil/commercial requirements for the manned space station (MSS) detracts from the strength of the presentation. Answers to the following questions would assist the report reader in understanding the value of the MSS.

(1) Which civil/commercial space requirements are uniquely enabled by the MSS?

(2) Which civil/commercial space requirements have enhanced satisfaction as a result of the MSS?

(3) Which civil/commercial space requirements could be satisfied without the MSS?

(4) In the area of space manufacturing, what aspects of the process specifically require permanent manned presence?

(5) What space manufacturing could be accomplished via the Shuttle and Shuttle tended space platforms?

There is little justification for various component parts of the program "scenarios." Additional information would be helpful in the following areas:

(6) What are the lower cost alternatives to the PEP to increase Shuttle in-orbit time? What are their capabilities and costs? What is the NASA evaluation of the recent Rockwell proposal?

(7) What is the cost effectiveness of the OTV versus expendable upper stages? How long would it take to amortize its DDT&E costs?

(8) What are the impacts of the MSS program on the Shuttle mission requirements? How many more Shuttles would be required to support the various MSS options?

The NASA case for the MSS is anchored on the premise that the Soviet Salyut program has had a significant negative impact on world perceptions of US space leadership. That premise is unsupported by any citation of documentation, polls, or studies. Have there been any such investigations? What were the results?

(9)

(10) The NASA program "scenario" options are presented briefly, but only the option endorsed by NASA has any significant presentation of capabilities, etc. Balanced presentations need to be made for alternate scenario options in terms of capabilities, shortcomings, costs and time lines. There would be value in looking at non-PEP alternatives to NASA scenario II. There would also be value in looking at the NASA III b scenario with a delayed IOC to minimize technical risk and cost. The compatibility of the various scenarios to upgrading if future requirements and funding enhancements become a reality should also be presented.

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I-1. Which civil/commercial space requirements are uniquely enabled by the MSS?

In the materials processing area, the production of high purity gallium arsenide crystals is enabled by a manned Space Station. In addition, the ability to move rapidly from research experiments to production is uniquely enabled by the manned Space Station. This is particularly true in the pharmaceutical products field. For example, from the first Shuttle experiment in 1982 to an automated production facility in space for the first Electrophoresis Operations in Space (EOS) products will require a minimum of five years. With a manned Space Station, the time could be reduced to about two years. Most importantly, the number of new pharmaceutical products which could be brought to the public over a ten year period, using the electrophoresis techniques, is estimated by McDonnell Douglas and Johnson and Johnson as ten using a permanently manned research facility versus two using Shuttle. In addition, the materials processing in space research and development laboratory enables the development of new products. Product development aboard the Shuttle only would result in such a protracted development schedule that the industrial community would consider such an investment as too risky and too far into the future.

In the field of commercial communications satellites, four capabilities are uniquely enabled by manned Space Station:

1. Rapid feedhorn reconfiguration at the station and redeployment of direct broadcast satellites.

2. Construction of large antennas required for land mobile communications satellites.

3. Assembly and deployment of large geosynchronous platforms which are serviceable and maintainable.

4. Satellite servicing at geosynchronous orbit (using a combination of the OTV and TMS).

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I-2. Which civil/commercial space requirements have enhanced satisfaction as a result of the MSS?

Materials production facilties are substantially enhanced by a manned Space Station. Down time of an attached production facility is reduced to near zero. Costly automation and multiple redundancy can be minimized. The key to commercial viability of a product is maximum product throughput at minimum cost. Thus, many products will not be brought to the market place unless the manned Space Station exists.

In the communications satellite field, a cost effective, resuable transportation capability, based at the station, permits assembly and checkout of satellite systems and on-demand launch to geosynchronous orbit, resulting in enhanced success rates and cost effective deployment. In addition, servicing of geosynchronous satellites becomes possible with the station capability. Thus, satellites can be maintained and upgraded in service for much longer times than currently possible.

As maintainability of space assets (i.e., satellites, payloads, experiments, etc.) matures, the manned Space Station will enhance the scheduled and, particularly, the unscheduled servicing of long life assets. Unscheduled service will also permit added value such as extended life or higher performance through on-demand upgrading of systems.

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I-3. Which civil/commercial space requirements could be satisfied without the MSS?

Some materials products can be brought to the market place without a manned Space Station. These include the electrophoresis products, although at a much lower production rate. Many new products would not be pursued by industry because of the ten year plus return on investments.

Communications satellite placement (at current needs and sizes) and commercial earth observation missions can be accommodated without a manned Space Station.

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I-4. In the area of space manufacturing, what aspects of the process specifically require permanent manned presence?

With respect to space manufacturing, manned intervention is crucial in the development of new materials such as extremely pure pharmaceuticals. For example, on STS-4, there were 55 manned interventions for the electrophoresis mid-deck experiments. McDonnell Douglas analyses indicate that manned intervention on a continuous basis would increase the number of pharmaceutical products being developed by a factor of five (5) as compared to three (3) using Shuttle and unmanned platforms. The Shuttle alone provides the capability for a degree of R&D for the development of pharmaceuticals, but clearly is not adequate for a production facility. McDonnell Douglas has estimated that 60 manned interventions were required on STS-6 and 50 on STS-7. It has been estimated that McDonnell Douglas/Johnson and Johnson will have invested $100 million of their corporate resources by 1986 in a commerical pharmaceutical manufacturing facility.

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I-5. What space manufacturing could be accomplished via the Shuttle and Shuttle tended space platforms?

With respect to the use of the Shuttle and Shuttle tended space platforms, the through-put would be decreased drastically per the McDonnell Douglas/Johnson and Johnson analyses. Therefore, the number of new pharmaceuticals that would be produced would be restricted and the attractiveness of the facility as a viable commercial entity would be severely degraded as opposed to a manned Space Station. Further, the operational costs would be greatly increased because of the extensive up and down Shuttle operatons.

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I-6. There is little justification for various component parts of the program "scenarios." Additional information would be helpful in the following areas:

What are the lower cost alternatives to the Power Extension Package to increase Shuttle in-orbit time? What are their capabilities and costs? What is the NASA evaluation of the recent Rockwell proposal?

NASA did consider the Power Extension Package (PEP) in the scenarios developed in the "NASA Capabilities Evaluation Document." The PEP did extend the on-orbit stay time of Shuttle from nine days to 20 days. Although over twice as long as present capability, it will not meet the predicted requirement for long durations manned tended mode. The Rockwell International proposal did not come to light until after the NASA Capabilities Evaluation Document was developed. The cryogenic kits, proposed by Rockwell, appear to be cheaper than the PEP, but full investigation of possible Shuttle modifications should be examined.

Here again, the cryogenic kits only extend the orbitor stay time to 20 days, and this is at significant cost to payload support capability.

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I-7. What is the cost effectiveness of the OTV versus expendable upper stages? How long would it take to amortize its DDT&E costs?

Contractor analyses have indicated that the full Space Station capability, including the space based OTV, could ultimately yield net benefits exceeding $5 billion (TRW briefing document NASW 3681, April 5, 1983). One major element in yielding these net benefits is the availability of a space based OTV to provide ready access to geosynchronous altitude. Since the space based OTV will be used for payloads other than commercial payloads (science, applications and military), an analysis as to the amortization of the OTV is not valid. In any case, with the data presently available, the precise traffic to geosynchronous altitude for the next 20 years is not known with great confidence. Therefore, it is not possible for us to conduct an amortization analysis.

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I-8. What are the impacts of the MSS program on the Shuttle mission requirements? How many more Shuttles would be required to support the various MSS options?

Approximately five (5) Shuttle launches would be required to assemble the first increment of the Space Station. The additional Shuttle launches required during the station's operations phase cannot be assessed since the traffic that will exist during the next 20 years is not settled. However, one of the benefits of the manned Space Station is the ability to agglomerate and support scientific instruments for a long period of time, thus eliminating the requirement to fly these instruments on the Shuttle and Spacelab in a sortie mode. From this standpoint, the existence of a Space Station could reduce the number of Shuttle launches. On balance, our current assessment indicates that the Space Station can be effectively integrated with our current Shuttle fleet. Because equipment, payloads and materials can be stored aboard the Space Station, each Shuttle flight can be manifested to a near 100% load factor, thus increasing effective Shuttle utilization.

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I-9. The NASA case for the MSS is anchored on the premise that the Soviet Salyut program has had a significant negative impact on world perceptions of US space leadership. That premise is unsupported by any citation of documentation, polls, or studies. Have there been any such investigations? What were the results?

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The Soviet's Salyut space station program supports important and sophisticated civil research in the field of astronomy, biology and materials processing. While activity of a military nature is also conducted onboard Salyut, the program has a strong civil tone. ' This tone is magnified by Soviet propaganda which emphasizes the station's civil activities and hides the Soviet military activity aboard Salyut. Salyut 6 and 7 -- and their successors -- appear to be the first step towards the permanent human occupancy of space. Moreover, they are represented, and are viewed by many, as a symbol of Soviet technology and skill. Hence, the program, particularly in the years ahead, represents a direct challenge to the perception of leadership in America's civil space program. Furthermore, as the intelligence community points out, a visible, highly publicized, continuously manned Soviet space program will receive frequent world-wide attention and will enhance Soviet prestige.

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I-10. The NASA program "scenario" options are presented briefly, but only the option endorsed by NASA has any significant presentation of capabilities, etc. Balanced presentations need to be made for alternate scenario options in terms of capabilities, shortcomings, costs and time lines. There would be value in looking at non-PEP alternatives to NASA scenario 11. There would also be value in looking at the NASA III b scenario with a delayed IOC to minimize technical risk and cost. The compatibility of the various scenarios to upgrading if future requirements and funding enhancements become a reality should also be presented.

An assessment as to the effectiveness and cost of the four (4) scenarios leading towards a permanent presence in space have been assessed and are contained in the NASA Capabilities Evaluation Document which has been submitted to the National Security Council as a background document supporting the findings in the SIG-Space Station Working Group summary report. All of the scenarios were assessed equally. Our current development plan encompasses a two year intensive systems definition prior to the initiation of flight hardware development. This intensive definition will minimize technical risk, establish reliable cost estimates, and provide a realistic schedule in order to secure a firm basis for development. Because of the planned definition activity, a delayed IOC will only serve to increase the program cost and delay the realization of benefits; it will not further minimize the technical risk or establish more reliable cost estimates.

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